CLAIMS

We claim:

1. A method of determining location of a mobile unit, the method comprising:

receiving signals from at least two base stations;

determining a time difference of arrival between the received signals;

estimating a lower bound of excess delay in accordance with the time of arrival of the signals and known distances between the base stations; and

estimating a location of the mobile unit in accordance with the estimated lower bound of excess delay and the time difference of arrival between the received signals.

2. A method as defined in Claim 1, wherein the received signals are CDMA pilot signals.

3. A method as defined in Claim 1, wherein the received signals are GSM signals.

4. A method as defined in Claim 1, further comprising adjusting the estimated location of the mobile unit using the lower bound of excess delay.

5. A method as defined in Claim 4, wherein the adjustment comprises subtracting the lower bound of excess delay from the time of arrival measurement for the respective signal.

6. A method as defined in Claim 4, wherein the adjustment comprises weighting the time of arrival measurements according to the lower bound of excess delay.

7. A method as defined in Claim 4, wherein the adjustment comprises eliminating a time of arrival measurement from the location estimate based on the lower bound of excess delay.

8. A method as defined in Claim 1, wherein the lower bound of excess delay for the received signals is used to determine an accuracy of the location estimate of the mobile unit.

9. A method as defined in Claim 1, wherein the excess delay introduced into the signals is due to multipath.

10. A method as defined in Claim 1, wherein signals are received at the mobile unit from a plurality of base stations and the lower bound on the excess delay is estimated for a plurality of signal time of arrival determinations.

11. A method as defined in Claim 1, wherein the signals received from the base stations are transmitted from the base stations at the same time.

12. A method as defined in Claim 1, wherein the signals received from the base stations are transmitted synchronized in time to each other.

13. A method as defined in Claim 1, wherein the received signals are communication signals.

14. A method as defined in Claim 1, wherein the received signals are cellular communication signals.

15. A method as defined in Claim 1 wherein, estimating the lower bound of excess delay is done with less than all of the signals received from the base stations.

16. A method as defined in Claim 1, wherein estimating location of the mobile unit includes another position location system.

17. A method as defined in Claim 16, wherein the other position location system is a global positioning system.

18. A mobile unit comprising:

a receiver configured to receive respective signals from at least two base stations, and to determine a time of arrival of the signals transmitted by each base station;

an excess delay engine configured to receive the time of arrival of the signals and to estimate a lower bound of excess delay in accordance with the time of arrival of the signals from their respective base stations and known distances between the base stations.

19. A mobile unit as defined in Claim 18, wherein the received signals are CDMA pilot signals.

20. A mobile unit as defined in Claim 18, wherein the received signals are GSM signals.

21. A mobile unit as defined in Claim 18, further comprising estimating a location of the mobile unit in accordance with the estimated lower bound of excess delay and the time difference of arrival between the received signals.

22. A mobile unit as defined in Claim 21, further comprising adjusting the estimated location of the mobile unit using the lower bound of excess delay.

23. A mobile unit as defined in Claim 22, wherein the adjustment comprises subtracting the lower bound of excess delay from the time of arrival measurement.

24. A mobile unit as defined in Claim 22, wherein the adjustment comprises weighting the time of arrival measurements according to the lower bound of excess delay.

25. A mobile unit as defined in Claim 22, wherein the adjustment comprises eliminating a time of arrival measurement from the location estimate based on the lower bound of excess delay.

26. A mobile unit as defined in Claim 21, wherein the lower bound of excess delay for the received signals is used to determine an accuracy of the estimated location of the mobile unit.

27. A mobile unit as defined in Claim 21, wherein the location estimate determined by the mobile unit is transmitted to a base station.

28. A mobile unit as defined in Claim 21, wherein estimating location of the mobile unit includes another position location system.

29. A mobile unit as defined in Claim 28, wherein the other position location system is a global positioning system.

30. A mobile unit as defined in Claim 18, wherein the lower bound of excess delay of the received signals is transmitted to one of the base stations.

31. A mobile unit as defined in Claim 18, wherein the delay introduced into the signal is due to multipath.

32. A mobile unit as defined in Claim 18, wherein the mobile unit is used in a communication system.

33. A mobile unit as defined in Claim 18, wherein the mobile unit is used in a cellular communication system.

34. A mobile unit as defined in Claim 18 wherein, estimating the lower bound of excess delay is done with less than all of the signals received from the base stations.

35. A base station comprising:

a receiver configured to receive signals from at least one mobile unit, wherein the signals received from the at least one mobile unit comprise the times of arrival of signals received by the mobile unit from at least two base stations; and

an excess delay engine configured to receive the times of arrival of the signals and to estimate a lower bound of excess delay for the times of arrival of the signals from their respective base stations wherein the base stations are located known distances apart.

36. A base station as defined in Claim 35, wherein an estimated location of a mobile unit is determined in accordance with the lower bound of excess delay and a time difference of arrival of the signals received.

37. A base station as defined in Claim 36, wherein the estimated location of the mobile unit is adjusted using the lower bound of excess delay.

38. A base station as defined in Claim 37, wherein the adjustment comprises subtracting the lower bound of excess delay from the time of arrival measurement of the respective signal.

39. A base station as defined in Claim 37, wherein the adjustment comprises weighting the time of arrival measurements according to the lower bound of excess delay.

40. A base station as defined in Claim 37, wherein the adjustment comprises eliminating a time of arrival measurement from the location estimate based on the lower bound of excess delay.

41. A base station as defined in Claim 36, wherein the lower bound of excess delay for the received signals is used to determine an accuracy of the estimated location of a mobile unit.

42. A base station as defined in Claim 36 wherein, estimating the lower bound of excess delay is done with less than all of the signals received from the mobile unit.

43. A base station as defined in Claim 36, wherein estimating location of the mobile unit includes another position location system.

44. A base station as defined in Claim 43, wherein the other position location system is a global positioning system.

45. A base station as defined in Claim 35, wherein the base station is used in a communication system.

46. A base station as defined in Claim 35, wherein the base station is used in a cellular communication system.

47. An integrated circuit configured to determine a lower bound of an excess delay in a time of arrival measurement of a received signal, the integrated circuit comprising:

a input circuit configured to receive signals from at least two base stations and to output a time of arrival measurement for each received signal;

an excess delay engine configured to determine a time difference of arrival between the received signals from the respective base stations, and to estimate a lower bound of excess delay introduced into the signals received from each base station

based on the time of arrival of each signal from its respective base station and a known distance between two associated base stations.

48. An integrated circuit as defined in Claim 47, wherein the received signals are CDMA pilot signals.

49. An integrated circuit as defined in Claim 47, wherein the received signals are GSM signals.

50. An integrated circuit as defined in Claim 47, further comprising estimated location of a mobile unit in accordance with the lower bound of excess delay and the time difference of arrival between the received signals.

51. An integrated circuit as defined in Claim 50, wherein the estimated location of the mobile unit is adjusted using the lower bound of excess delay.

52. An integrated circuit as defined in Claim 51, wherein the adjustment comprises subtracting the lower bound of excess delay from the time of arrival measurement.

53. An integrated circuit as defined in Claim 51, wherein the adjustment comprises weighting the time of arrival measurements according to the lower bound of excess delay.

54. An integrated circuit as defined in Claim 51, wherein the adjustment comprises eliminating a time of arrival measurement from the estimated location based on the lower bound of excess delay.

55. An integrated circuit as defined in Claim 50, wherein the lower bound of excess delay for the received signals is used to determine an accuracy of the estimated location of the mobile unit.

56. An integrated circuit as defined in Claim 50, wherein estimating location of the mobile unit includes another position location system.

57. An integrated circuit as defined in Claim 56, wherein the other position location system is a global positioning system.

58. An integrated circuit as defined in Claim 47, wherein the delay introduced into the signals is due to multipath.

59. An integrated circuit as defined in Claim 47 wherein, estimating the lower bound of excess delay is done with less than all of the signals received.

60. A method of determining location of a mobile unit, the method comprising:

receiving signals from at least two base stations and determining the time of arrival at the mobile unit for the respective signals;

determining the time difference of arrival between the received signals from the respective base stations;

estimating a lower bound of excess delay in accordance with the time of arrival of the signals from their respective base stations and known distances between the base stations; and

transmitting the time difference of arrival and lower bound of excess delay to a different location and estimating location of the mobile unit in accordance with the estimated lower bound of excess delay and the time difference of arrival between the received signals at the different location.

61. A method as defined in Claim 60, wherein the different location is a base station.

62. A method of determining location of a mobile unit, the method comprising:

receiving signals from at least two base stations and determining the time of arrival at the mobile unit for the respective signals;

transmitting the times of arrival of the signals to a different location;

determining the time difference of arrival between the received signals from the respective base stations at the different location;

estimating a lower bound of excess delay in accordance with the time of arrival of each signal from its respective base station and a known distance between the base stations at the different location; and

estimating location of the mobile unit in accordance with the estimated lower bound of excess delay and the time difference of arrival between the received signals at the different location.

63. A method as defined in Claim 62, wherein the different location is a base station.

64. A mobile unit comprising:

a receiver configured to receive respective signals from at least two base stations, and to determine a time of arrival of the signals transmitted by each base station; and

a transmitter configured to accept the time of arrival and to transmit the time of arrival to a different location.

65. A mobile unit as defined in Claim 64, wherein the different location further comprises:

an excess delay engine configured to receive the time of arrival and estimate a lower bound of excess delay in accordance with the time of arrival of the signal from its respective base station and a known distance between the base stations, and estimating location of the mobile unit in accordance with the estimated lower bound of excess delay and the time difference of arrival between the received signals.